VEHICLE SUSPENSION WITH A DOCK HEIGHT HOLDING DEVICE

BACKGROUND OF THE INVENTION

[1] This invention generally relates to vehicle suspensions. More particularly, this invention relates to an arrangement for maintaining a desired dock height of a vehicle under selected conditions.

[2] Vehicle suspensions are well known. Many arrangements for trucks or other heavy vehicles include air-based suspension components commonly known as air springs. Typical arrangements include a dump valve to exhaust air from the air springs when vehicle parking brakes are applied. As air is evacuated from the air springs, the height of the trailer or rear end of the truck (depending on the vehicle configuration) typically drops from a ride height until an appropriate suspension component rests on a jounce bumper internal to the air springs. It is desirable to exhaust the air from the air springs to provide a stable trailer deck for safely loading and unloading cargo from the trailer or truck.

[3] A difficulty associated with conventional arrangements is that when the trailer or rear end of the truck drops as air is exhausted from the air springs, there is an undesirable mismatch between the trailer deck height and the loading dock height. Under some circumstances, a mismatch between the trailer deck height and the dock height prevents a forklift or other vehicle from moving into and out of the trailer for transferring the cargo.

[4] One proposed solution has been to include a non-dump height control valve such that air is not evacuated from the air springs when parking brakes are applied. This solution is not ideal, however. In many instances, attempting to load or unload a trailer without first exhausting air from the air springs results in undesirable bouncing and creates a possible safety concern. It is best to have the truck or trailer as stable as possible during loading or unloading operations.

[5] Accordingly, there is a need for a safe and stable arrangement that allows loading and unloading a trailer while maintaining a desired height of the deck of the truck or trailer. This invention addresses that need and avoids the shortcomings and drawbacks of prior attempts.

SUMMARY OF THE INVENTION

[6] In general terms, this invention is a vehicle suspension assembly having a dock height holding device. An assembly designed according to this invention includes a first support member attached to a body of the vehicle. A second support member moves relative to the first support member. At least one air spring is coupled with the first and second support members to provide load transfer and relative movement between them. A height holding device is positioned within the air spring and supported on one of the support members. The height holding device has a moveable portion that is moveable from a first position where the moveable portion permits relative movement between the support members (such as during normal driving conditions) into a second position where the moveable portion prevents relative movement between the support members (such as during loading or unloading).

[7] The height holding device preferably includes a hydraulic ram that is moved into a position to maintain a desired height of a trailer deck or truck bed, for example.

[8] The various features and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiments. The drawings that accompany the detailed description can be briefly described as follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[9] Figure 1 schematically illustrates selected portions of a vehicle suspension assembly designed according to this invention.

[10] Figure 2 illustrates, in somewhat more detail, selected portions of another example suspension assembly designed according to this invention.

[11] Figure 3 schematically illustrates portions of the embodiment of Figure 1 in a first operating condition.

[12] Figure 4 illustrates the components of Figure 3 in a second operating condition.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[13] A vehicle suspension assembly 20 is particularly useful for heavy vehicles such as truck and trailer arrangements. The illustrated example is especially useful for truck trailers that are used in carrying a variety of cargo.

[14] The suspension assembly 20 includes a first support member 22 that is supported on the vehicle body in a conventional fashion. The first support member 22 can be referred to as part of the sprung mass of the vehicle. A second support member 24 is supported to move relative to the first support member 22. The second support member 24 is associated with a vehicle axle 26 and can be considered part of the unsprung mass of the suspension arrangement.

[15] An air spring 30 is positioned between the first support member 22 and the second support member 24 to provide load transfer during relative movement between the support portions as the vehicle travels along a road surface, for example. The air spring 30 includes a retainer plate 32 that is supported for movement with the second support member 24. An upper bead plate 34 is supported to remain stationary relative to the first support member 22. A bellows portion 36 extends between the retainer plate 32 and upper beat plate 34 and is filled with air in a conventional fashion. Adjusting the air pressure within the bellows 36 adjusts the amount of load carrying capacity provided by the air spring 30.

[16] A height holding device 40 is at least partially supported within the bellows 36. The height holding device 40 preferably includes a hydraulic ram having a stationary portion 42 and a moveable portion 44. A support plate 46 is associated with the moveable portion 44 and supports a jounce bumper element 48.

[17] The moveable portion 44 preferably is moved relative to the stationary portion 46 using hydraulic pressure. A pressure source 50 provides pressure through a conduit 52 and an inlet port 54. The inlet port 54 preferably is controlled by a controller 56 to selectively control the amount of pressure provided to the hydraulic ram. The controller 56 preferably communicates with the pressure source 50 and a vehicle parking brake device 58. The controller 56 preferably controls the supply of pressure to the hydraulic ram responsive to actuation of the parking brake.

[18] It is possible to mount the hydraulic ram onto the retainer plate 32 such as shown in Figure 2 or onto the upper bead plate 34 such as shown in Figure 1. Mounting the device 40 to be supported by the bead plate 34 and the support member 22 is preferred. In this position, the device 40 is part of the sprung mass of the vehicle. Those skilled in the art who have the benefit of this description will be able to choose the appropriate position based upon the particular vehicle configuration to which they are applying this invention. In the example of Figures 1, 3 and 4, the

hydraulic ram is secured to the bead plate 34. In the example of Figure 2, the hydraulic ram is secured to the retainer plate 32.

[19] A first seal 60 and a second seal 62 preferably are provided to prevent air pressure from escaping from the bellows during normal suspension driving conditions. In one example, a filet weld is used at 64 to seal the interface between the stationary portion 42 and the associated component within the air spring 30.

[20] A shaft 66 preferably extends at least partially outside of the air spring. The shaft 66 not only provides a mounting stud for the hydraulic ram assembly but also includes a central bore that acts as a hydraulic port for supplying pressure for the hydraulic ram operation.

[21] During normal driving conditions, the moveable portion 44 preferably is in a first, retracted position relative to the stationary portion 42 (see Figure 3). The moveable portion 44 preferably is biased into this first position by a biasing member. The illustrated example includes a spring 68 that urges the moveable portion 44 into the first, retracted position.

[22] In the first position, the jounce bumper 48 and the opposing plate of the air spring assembly are typically spaced apart because of the air pressure within the bellows 36. Under certain driving conditions or when the air pressure is released, contact will be made between the jounce bumper 48 and the corresponding oppositely facing portion of the air spring assembly (i.e., the retainer plate 32 in Figures 3 and 4). Accordingly, a minimum spacing h_1 is maintained between the upper bead plate 34 and the retainer plate 32 regardless of the amount of pressure supplied to the bellows 36. In other words, the jounce bumper portion 48 will contact the retainer plate 32 under certain conditions and the dimensions of the hydraulic ram and the jounce bumper portion 48 ensure a minimum clearance h_1. This corresponds to a minimum clearance between the first support member 22 and second support member 24 of the suspension assembly.

[23] Under certain conditions, such as when a vehicle is parked at a loading dock, it is desirable to maintain a ride height of the truck or trailer bed. The controller 56 preferably determines when the parking brake assembly 58 has been activated. The controller 56 preferably then controls the operation of the inlet port 54 and the pressure supply 50 to apply hydraulic pressure to the ram 40. The moveable portion 44 responsively moves outwardly away from the stationary portion 42 into a second

position where the jounce bumper 48 contacts the retainer plate 32. In one example, a total travel of about three inches will be normal.

[24] The amount of pressure applied to the hydraulic ram preferably is enough to cause the moveable portion 44 to move into the contact position as schematically illustrated in Figure 4. It is preferred not to apply any additional pressure to attempt to cause any separation between the upper bead plate 34 and the retainer plate 32, which would cause a corresponding rise in the height of the truck or trailer bed. The preferred arrangement includes applying only enough pressure to make contact and then to maintain the height or clearance h_2, which corresponds to the ride height of the truck or trailer bed.

[25] The controller 56 preferably controls the port 54 so that the hydraulic ram is locked into a position corresponding to the desired height of the truck or trailer bed during loading and unloading. Once the hydraulic ram is in position, the air pressure from the bellows 36 may be evacuated without any concern of the truck or trailer bed dropping from the ride height, which is desired to permit loading and unloading of the truck or trailer cargo.

[26] Once the controller 56 determines that the vehicle operator wishes to drive the vehicle again, such as by determining that the parking braked has been released, then the port 54 is controlled to release pressure from the hydraulic ram so that the moveable portion 44 is retracted back into the first position. In the illustrated example, the spring 68 draws the moveable portion 44 back into the first position.

[27] The signals received by the controller 56 may be pressure signals or electrical signals depending on the configuration of the particular vehicle brake assembly. Because many vehicles include a spring applied, air release parking brake assembly, air signals are preferred. Those skilled in the art who have the benefit of this description will be able to choose the appropriate components to realize the necessary control of the height holding device designed according to this invention to meet the needs of a particular situation.

[28] A vehicle suspension assembly designed according to this invention takes advantage of existing vehicle components and incorporates a unique deck height holding device that easily fits within current vehicle packaging constraints.

[29] The preceding description is exemplary rather than limiting in nature. Variations and modifications to the disclosed examples may become apparent to those skilled in the art that do not necessarily depart from the essence of this invention. The

scope of legal protection given to this invention can only be determined by studying the following claims.